

U.S. Patent Application Serial No. 10/542,029  
Amendment filed July 23, 2007  
Reply to OA dated February 22, 2007

**REMARKS**

Claims 1, 6 and 8-13 are pending in this application. The present amendment cancels claims 1 and 13 without prejudice or disclaimer, amends claims 6 and 8-12, and adds new claim 14. Upon entry of this amendment, claims 6, 8-12 and 14 will be pending.

No new matter has been introduced by this Amendment. Support for the amendments to the claims is detailed below.

**The rejection of claims 1, 6 and 8-12 under 35 U.S.C. 103(a) as being unpatentable over WO 00/31027 ('027) and Eiermann et al. (U.S. Patent No. 6,531,629 B1) in combination with Nobel et al. (U.S. Patent No. 4,871,429) is maintained. (Office action, page 3)**

Reconsideration of the rejection is respectfully requested in view of the amendments to the claims. The rejection of claim 1 is moot in view of the cancellation of claim 1 without prejudice or disclaimer. In the amendment, claims 6, 8, 9, 11 and 12 are amended to be method claims depend from new independent method claim 14, such that all of claims 6 and 8-12 depend ultimately from claim 14.

In new method claim 14, purified aliphatic sulfonic acid obtained by purifying an aliphatic sulfonic acid obtained by hydrolyzing an alkylsulfonyl halide is used as a base acid for the tin-coating plating bath. Support for this amendment may be found in original claim 1, and in the general disclosure on page 14 of the specification. In particular, support for the recitation regarding the 200 ppm limit on dimethyldisulfide may be found in original claim 2, the 4 ppm limitation on

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the amount of S-methyl methanethiosulfonate may be found in original claim 3, the 4 ppm limitation on the amount of  $\alpha$ -chlorodimethyl sulfone may be found in original claim 4, and the 4 ppm limitation on the amount of  $\alpha$ -methylsulfonyl- $\alpha,\alpha$ -dichlorodimethylsulfone may be found in original claim 5. The present amendment clarifies that the method of the invention involves adding component (b), where “component (b) comprises a purified aliphatic sulfonic acid obtained by purifying an aliphatic sulfonic acid which has been produced by hydrolyzing an alkylsulfonyl halide.”

Since the present claims are amended to be **method** claims, the previously raised issues regarding the amounts of impurities that would be inherently be present in prior art plating baths, are now moot. Applicant submits that the prior art does not disclose or suggest the method limitations of the present claims.

Specifically, Eiermann et al. (US Patent No. 6,531,629) relates to a process for the preparation of alkanesulfonic acids, and discloses that the obtained alkanesulfonic acids can be used as additives for a tin plating liquid for printed circuit boards. However, Eiermann et al. discloses, as the process for preparing alkanesulfonic acids, only a method for oxidizing alkylmercaptans and/or dialkyl disulfides and/or dialkyl polysulfides with nitric acid, and indicates that an alkanesulfonic acid obtained by distilling and purifying the alkanesulfonic acid obtained by the method is suitable for an electrochemical bath.

Applicant submits that Eiermann et al. is totally silent on adverse effects of specific impurities contained in the alkanesulfonic acid on the properties of tin-containing plating films, and

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that there is no suggestion in Eiermann et al. for using an aliphatic sulfonic acid which has been produced by hydrolyzing an alkylsulfonyl halide, then purifying. There is also no suggestion in Eiermann for meeting the limitations of the present claims on the amounts of dimethyldisulfide, S-methyl methanethiosulfonate,  $\alpha$ -chlorodimethylsulfone and  $\alpha$ -methylsulfonyl- $\alpha,\alpha$ -dichlorodimethylsulfone.

Nobel et al. discloses the use of a soluble metal salt in a tin-containing plating bath or a tin alloy-containing plating bath. However, Nobel also does not suggest using an aliphatic sulfonic acid which has been produced by hydrolyzing an alkylsulfonyl halide, then purifying, and does not suggest meeting the limitations of the present claims on the amounts of dimethyldisulfide, S-methyl methanethiosulfonate,  $\alpha$ -chlorodimethylsulfone, and  $\alpha$ -methylsulfonyl- $\alpha,\alpha$ -dichlorodimethylsulfone.

In addition to the above arguments, Applicant also submits that the advantages of meeting the limitations of the present claims are unexpected over the cited references. Both Eiermann and Nobel et al. are totally silent about adverse effects of specific sulfur-containing compounds on the properties of plating films in a case where the aliphatic sulfonic acid obtained by hydrolyzing an alkyl sulfonyl halide is used as a base acid for a tin-coating plating bath, which have been demonstrated in the present specification.

As described in the specification on page 7, lines 21 to 23, the aliphatic sulfonic acid obtained by hydrolyzing an alkylsulfonyl halide may contain various halogen- and sulfur-containing compounds as impurities other than the intended aliphatic sulfonic acid.

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The invention as defined in claim 14 of this application makes it possible to obtain an excellent plating film by preparing a tin-containing plating bath containing, as a base acid, a purified aliphatic sulfonic acid obtained by purifying an aliphatic sulfonic acid obtained by hydrolyzing an alkyl sulfonyl halide in such a manner as to adjust the concentrations of sulfur-containing compounds in a tin-containing plating bath as follows: dimethyldisulfide is present in the bath in an amount of less than 200 ppm, S-methyl methanethiosulfonate is present in the bath in an amount of less than 4 ppm,  $\alpha$ -chlorodimethylsulfone is present in the bath in an amount of less than 4 ppm, and  $\alpha$ -methylsulfonyl- $\alpha,\alpha$ -dichlorodimethyl sulfone is present in the bath in an amount of less than 4 ppm.

In particular, it cannot be predicted from the description of Eiermann et al., or that of Nobel et al, or of the two references combined, that the reflowability, film appearance, etc., of plating films are sharply improved by the method of the present invention, in which the purified aliphatic sulfonic acid obtained by the process completely different from that of Eiermann et al. is used as a base acid for a tin-containing plating bath so as to meet the concentration limitations of claim 14.

Applicant therefore submits that claims 6 and 8 to 12, as amended, are not obvious over Eiermann et al. and Nobel et al., taken separately or in combination.

**Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over WO 00/31027 ('027) and Eiermann et al. (U.S. Patent No. 6,531,629 B1) in combination with Nobel et al. (U.S. Patent No. 4,871,429) as applied to claims 1-12 above, and further in view of IBM (Technical Disclosure Bulletin, Vol. 32, No. 3B, August 1, 1989, pp. 36-37). (Office action, page 6)**

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The rejection is moot in view of the cancellation of claim 13 without prejudice or disclaimer.

**Claims 1, 6 and 8-13 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. (Office action, page 7)**

Reconsideration of the rejection is respectfully requested in view of the amendments to the claims.

The Examiner states that the phrases "the content of dimethylsulfide," "the content of S-methyl methanthiosulfonate," etc., lack antecedent basis.

The present claims have been amended for clarity to not use the term "the content."

With regard to claim 8, the Examiner refers to the wording "is one obtained by" in line 2, and questions the meaning of the word "one." The word "one" has been deleted in this phrase in claims 8-11. Applicant submits that the word "one" was redundant, and there is no change in meaning by this amendment.

The Examiner also refers to the phrase "subjecting an aliphatic sulfonic acid to concentration under reduced pressure" in claim 8, asking whether this refers to the "purifying an aliphatic sulfonic acid" in claim 1. The claims have been amended: "subjecting an the aliphatic sulfonic acid produced by hydrolyzing an alkylsulfonyl halide" to clarify this recitation.

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**Claims 1, 6 and 8-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nobel et al. (U.S. Patent No. 4,871,429) in combination with Henderson et al. (U.S. Patent No. 5,583,253).** (Office action, page 11)

Reconsideration of the rejection is respectfully requested in view of the amendments to the claims. The rejection of claim 1 is moot in view of the cancellation of claim 1 without prejudice or disclaimer. In the amendment, claims 6, 8, 9, 11 and 12 are amended to be method claims depend from new independent method claim 14, such that all of claims 6 and 8-12 depend ultimately from claim 14. Support for the claim amendments has been detailed above.

As discussed above, Nobel et al. discloses a tin-containing plating bath or a tin alloy-containing plating bath, but does not disclose or suggest using an aliphatic sulfonic acid which has been produced by hydrolyzing an alkylsulfonyl halide, then purifying. Moreover, Nobel et al. does not disclose the adverse effects of specific sulfur-containing impurities on the properties of tin-containing plating films when an aliphatic sulfonic acid obtained by hydrolyzing an alkylsulfonyl halide is used as a base acid for a tin-containing plating bath.

Henderson et al. relates to a process of preparing purified alkanesulfonic acid, and discloses a process comprising treating a crude alkanesulfonic acid containing oxidizable impurities with chlorine to convert the oxidizable impurities to the corresponding alkanesulfonyl chloride, and hydrolyzing the alkanesulfonyl chloride to alkanesulfonic acid. However, as described in Henderson et al. column 2, lines 6 to 12, crude MSA to be purified in the process of Henderson et al. is prepared by the reaction of methyl mercaptan with chlorine and is **not** an aliphatic sulfonic acid obtained by

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hydrolyzing an alkyl sulfonyl halide. Henderson et al. merely discloses a process of treating oxidizable impurities contained in the above-mentioned crude MSA with chlorine to convert the oxidizable impurities to MSC, and then hydrolyzing the MSC to yield MSA as a process of reducing the oxidizable impurities contained in the crude MSA obtained by the above-described method. More specifically, according to the process of Henderson et al. the alkanesulfonic acid to be purified is a crude MSA obtained by the reaction of methyl mercaptan with chlorine as a main ingredient. An alkyl sulfonyl halide is formed as a result of chlorinating the oxidizable impurities contained in a crude MSA, and an aliphatic sulfonic acid obtained by hydrolyzing the alkyl sulfonyl halide is merely a part of the purified alkanesulfonic acid. Moreover, Henderson et al. nowhere discloses further purifying the aliphatic sulfonic acid obtained by hydrolyzing the alkyl sulfonyl halide.

Therefore, the combination of Henderson et al. with Nobel et al. would not meet the method limitations of claim 14, in which a purified aliphatic sulfonic acid obtained by further purifying aliphatic sulfonic acid obtained by hydrolyzing an alkyl sulfonyl halide is component (b), dissolved in water in the preparation of the tin-containing plating bath.

Applicant submits that there is no suggestion in Henderson et al. for purifying the aliphatic sulfonic acid obtained by such a specific production process. Moreover, there is no suggestion in Henderson et al. for the compositional limitations of claim 14, since Henderson does not specifically discuss making plating baths.

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In addition, the advantages of reflowability, film appearance, etc., of plating films discussed above for the present invention, are clearly unexpected over the combination of Nobel et al. and Henderson et al.

Therefore, claims 6, 8 to 12, and 14 are not obvious over Eiermann et al. and Henderson et al., taken separately or in combination.

**Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nobel et al. (U.S. Patent No. 4,871,429) in combination with Henderson et al. (U.S. Patent No. 5,583,253) as applied to claims 1, 6 and 8-12 above, and further in view of IBM (Technical Disclosure Bulletin, Vol. 32, No. 3B, August 1, 1989, pp. 36-37). (Office action, page 16)**

The rejection is moot in view of the cancellation of claim 13 without prejudice or disclaimer.

Reconsideration of the rejections is therefore respectfully requested.

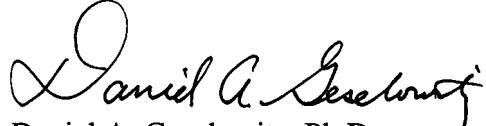
If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact the Applicant's undersigned agent at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

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In the event that this paper is not timely filed, the Applicant respectfully petitions for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

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PATENT TRADEMARK OFFICE

Enclosure: Petition for Extension of Time  
Request for Continued Examination (RCE) Transmittal

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